HAND-BOOK

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OF THE

SULPHUR-CURE,

AS APPLICABLE TO THE

VINE DISEASE IN AMERICA,

AND DISEASES OF

APPLE AND OTHER FRUIT TREES.

By WILLIAM J. FLAGG,

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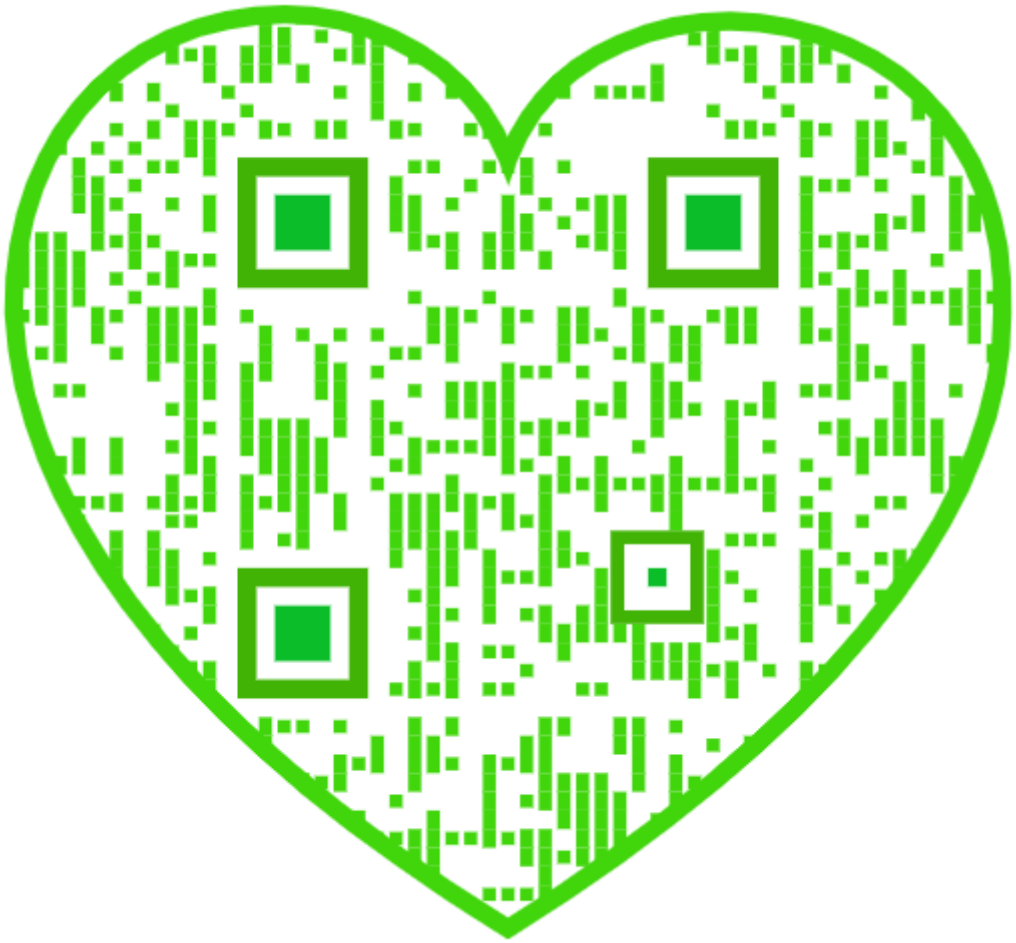

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PREFACE.

AT the request of many vine-growers who had become acquainted with my completely successful treatment of "mildew" by the sulphur-cure as learned in Europe, I undertook to set down a few brief precepts and rules for the guidance of such persons as might be disposed to follow my example. The work has grown into something like a treatise, and become much larger than I at first proposed to make it; and yet a good deal is omitted that might, perhaps, profitably be included, because I have thought it prudent to wait and observe for one or two seasons more, and also collect the observations and opinions of others, whose co-operation I now solicit, before attempting to write a work that shall cover the whole ground. And I here give notice that I write as a learner rather than a teacher, and reserve the right to confess my errors as often as I shall become aware of them.

Thus premising, I venture to affirm that the need for this little work is most urgent. So far as I have, with diligent inquiry, been able to learn, the methods for sulphuring diseased vines at present known to the grape-growers of America (except only as embodied in my lately published work on European Vineyards) are wholly insufficient, and can, in our climate, lead to nothing but failure and discouragement. The reasons for this will be developed in the pages which follow.

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HAND-BOOK

OF

THE SULPHUR-CURE.

CHAPTER I.

IN my volume entitled "THREE SEASONS IN EUROPEAN VINEYARDS," published in the spring of 1869, I strove to arouse my fellow-grape-growers to a sense of their danger from the spread of the vine disease, and to encourage them to adopt the remedy which had proved so efficacious in other countries, and try it, as I myself was resolved to try it, thoroughly, faithfully, hopefully. But my words had little effect.

Since then, events have come to my aid. A season of pestilence far more fatal than ever known before has dispelled those illusions of safety so fondly cherished, and blighted all those fanciful, various, and often conflicting theories invented to prove that certain soils or situations, or certain new varieties of vine, must forever remain safe and invulnerable.

He who would persuade a sick man to take medicine finds he has gained an important point when the patient is induced to admit that he really is ill. I think that to-day there are few who will deny there are sick vines—very sick ones—on the hills of the Ohio, on the bluffs of the Missouri, on the shores and islands of the Lake—sick Concords, disordered Delawares, suffering Ives's, diseased Nortons, and dead Catawbas.

But how shall I go about it to establish the next point, namely, that there is a remedy at hand perfectly efficient to arrest the plague, and turn back our afflicted industry from the very gates of death?

I can point to the fact that, the disease being a fungus, sulphur is scientifically known to destroy all kinds of fungi. I can refer to numerous instances, well known and often published, wherein the same disease, appearing in greenhouses, has been unfailingly cured by means of sulphur sprinkled on the hot pipes. I can relate how, during that same sickly season of 1869, I treated with sulphur my own vineyard of twelve year old Catawbas, in that doomed district, the Ohio Valley, and which had for the four preceding years been ravaged by the pest, and how I succeeded completely, as I knew I should, after what I had learned in Europe. Or I might cite other cases,

where, though success was somewhat less complete, yet sufficient was obtained to prove that sulphur has a marked specific power over the disease. But these cases, even if admitted and believed, are unfortunately met by others in which the same remedy has been tried and failed—that is to say, sulphur has been sprinkled, and yet the grapes have decayed.

I might appeal to the experience of European countries, where, during fourteen years, the sulphur-cure has been their sole and yet sufficient reliance against the terrible oïdium, which, during the three or four years of its first irruption, swept every thing before it; but men will not easily believe in facts that are remote, and are averse to stretch their belief across an ocean. I am myself an example, for it was not until I had traveled through those countries that I really comprehended and believed what I had, nevertheless, often enough, through books, journals, and word of mouth, been credibly informed was true. And even there—even in France, before the panic-stricken cultivators could be induced to try the simple remedy, Marès, De la Vergne, and others were obliged to conduct experiments on a large scale, and through a series of years, in many different districts, under governmental auspices; and the latter had to publish, besides numerous articles in the journals, as

many as thirteen separate pamphlet treatises, and, furthermore, to go about from commune to commune, and from one department to another, delivering lectures and holding discussions.

Wherefore, and aware of the difficulties of the situation, in now asking for a new hearing and a better heeding, I invoke the aid of all willing vine-dressers, and the prayers of all good Christians.

CHAPTER II.

THE OÏDIUM.

THE vine disease, as they know it in Europe, is a little mushroom, a vegetable parasite, which fastens to and grows upon the surfaces of the different parts of the grape-vine. It is scientifically termed "*Erysephe*" more properly than "*Oïdium*," and is classified as a *cryptogam* of the family of *Mucedines*. To the naked eye it appears only as a fine whitish dust, covering portions of the leaves, buds, stalks, fruit, or fruit-stems. Its existence was first discovered in the year 1845 on the vines of a greenhouse in Margate, England, whence it soon found its way across the Channel into France, and thence spread rap-

idly over all Europe, carrying swift destruction wherever it went, and exciting the utmost dismay. In the Memoir of Mr. Marès it is described as follows:

"The essential characteristics of the disease of the vine are every where the same, whether observed at Margate, where it first appeared, or at Madeira, or in the South of France. At the same time, the appearance, the exterior aspect of the diseased vine, its "*facies*," in a word, vary with the variety of vine attacked, its force, its development; it varies also according as the attack is recent or remote—the case one of a few days' standing, or one several weeks old. Finally, the disease affects certain particular forms, which seem to change its nature (the red-leaf or rougeau, for instance), and which give it a special malignity. It is all these causes united which have, without doubt, called forth so many different hypotheses relating to this disease.

"If, in summer-time, we examine a vine that has been some few days diseased, we shall find it to have a languishing aspect. The color of its foliage has lost its liveliness and shine, and turned to a livid yellow. The green parts (the product of the year) are covered here and there, over all their surface, with a sort of whitish dust, but slightly adhesive, from which continually exhales a musty odor *sui generis*. This

dust is, in fact, a species of mould. It is formed by the different parts of a little cryptogam parasite of the family of Mucedines. This it is that has been named by Mr. Berkley *Oïdium Tuckeri.*

"In measure as the divers characteristics just mentioned are developed, the vine appears attacked with a species of leprosy, which devours at the same time its stalks, leaves, and fruit. The old wood and the roots are not the seat of any alteration.

"The light patches of white dust with which the young shoots are covered, take, at the end of a few days, a gray color; they form, in the places they occupy, brown spots [De la Vergne, another writer, describes them as brown, black, or violet], which remain separate or run together, according to their nearness or to the persistence of the malady.

"This effect shows itself over the whole circumference of the shoot, but is more marked and more quickly produced on the upper side, where it is the most exposed to the sun's rays. These shoots grow but little. From the axils of their leaves issue numerous secondary branches of a particularly sickly aspect. This abnormal growth of stalk is a characteristic trait, and indicates a profound disturbance in the vegetation of the vine. It is local—that is to say, it will only be observed on those shoots that have

been invaded by the white dust, and later by the brown spots.

"The youngest leaves at the ends of the branches are generally crisped; they curl more or less, the under side within. Their upper sides are sprinkled with light white dust, in patches more or less irregular; it is the same with their under sides; it is always these which are the first and the most seriously attacked. When the leaf is covered with down, the cryptogamic vegetation forms on it a peculiar sort of felt easily recognizable. When the disease reappears on a vine (that has been attacked before), the first symptoms commence, almost always, by manifesting themselves on the under side of the young leaves by these patches of felt. The leaf-stem becomes covered with black spots,* like the stalk of the shoot from which it grows. The grapes attacked by the disease become likewise covered with white dust, but much more abundantly than the shoots and leaves; sometimes they are completely covered, sometimes invaded only here and there, on a single grain in a bunch, or even a portion of a grain. The more recent the disease, the more white the dust remains, and the more "greasy" to the

* Before described as brown. I suppose that, as is true of spots produced by the vine-disease in this country, these are black to the naked eye, but brown when magnified.

touch; if it is brushed off by rubbing the surface of the grain, no traces of it will remain on the skin; that will remain still intact. At the end of several days, however, the dust will turn gray; then, if rubbed off, little black spots will appear scattered over the place it occupied."

After remarking that these spots never go deeper than the outer skin either of the fruit or other green parts, and that the same spots slightly roughen the surface, and are the seat of disorganizations whose consequences are ruinous, hardening the skin (so much more delicate in the European grapes than in ours), so that, as the berries swell in growing, they crack open to the centre, often showing their pits. The same author goes on to say—

"The loss is much more rapid when the attack comes just after blossoming. The small size of the berries renders the disorganization of their whole surfaces easy; then they cease growing and dry up. When the attack finds the grape approaching maturity, it resists better. It seems to accomplish regularly the divers stages of its development; but, at the moment of ripening, the grain wilts, and considerable loss ensues, especially if the crop is not immediately gathered." Again he says:

"The vine may be attacked at any age and at all

epochs of vegetation, from the moment when the bud breaks out of its envelope down to the time when the leaves fall. It is easy to comprehend that between these two extremes there is a crowd of intermediate degrees, but at bottom the characteristics of the disease are always the same:

"Whitish dust (exhaling a musty odor) spread over the surfaces of the green parts to the exclusion of the old wood; disorganizations caused by this dust, which is composed of microscopic mushrooms (*oïdium Tuckeri*); evident trouble in the vegetation of the branches whose fruit, leaves, or stalks are invaded."

M. de la Vergne agrees that, though the fungus in question has obtained the name of *oïdium*, it should properly be called an *erysephe;* while the author before quoted speaks of it as "*the oïdium, or erysephe of the vine.*" In common words, it is a fungus—a mushroom. De la Vergne claims to have discovered, as early as 1863, three different varieties of oïdium, which have successively followed the first, each one being less malignant than the one that came before it, and all of them less malignant than the original.

In treating of the vine disease as known in America, I will call it neither oïdium, cryptogam, erysephe, nor mucedine, but give it the name it commonly goes by, which is *mildew.*

CHAPTER III.

THE MILDEW.

SOON after the oïdium got abroad in Europe, it became known that the vines of this country were being affected by a disease so nearly resembling it, to say the least, that, by most persons concerned, the two were supposed to be one and the same. Afterward, however, this came to be disputed, and, on very respectable authority, it was asserted that the fungus or mushroom, whose presence and growth on the vines produced, or rather constituted, the disease termed in Europe oïdium, was not the same as that which constituted the disease termed in America mildew, but was another and different one.

Practically this distinction does not make any difference, yet I regret it has been made; for, although it is conceded that sulphur destroys one fungus as well as another, and is the well-known specific for diseases from fungus parasites, yet the mere fact that such a distinction has been made has seriously impeded the

progress in this country of that faith in the sulphur-cure which the triumphant success following its adoption on the other side of the water was otherwise calculated to promote. Therefore it is proper this matter, microscopic as it is in every respect, should be decided one way or the other, and I agree it is time it should be done. And here it may seem strange that one should write on the subject of mildew without having an opinion on the point. If I am without one, however, it is only because I rested firmly in the belief that oïdium and mildew were one and the same, and not two and different, until the opportunity had passed for making a thorough microscopic examination. Before next September comes, I hope to resolve my own doubts at least. Meanwhile I may be allowed to doubt when, after seeking the opinions of distinguished chemists as well as others who have investigated the subject, I find myself unable to reconcile their conflicting judgments.

Here are some of the points of difference that are claimed to exist between what is called oïdium in Europe and what is called mildew in this country.

First, Though the effects on the fruit of the earlier attacks, which find it young and barely formed, are the same there as here, yet those forms of decay which

follow the later attacks are generally different. In Europe we hear mostly of the fruit cracking open, while in America we notice chiefly the gray rot. I have observed, however, that the Nortons do crack, even to showing their seed; and if our grapes of the Fox family, which comprises nearly all we cultivate besides the Nortons and Herbemont, had not such thick skins, I fancy they would crack too; but they being defended, after reaching a certain size, by a kind of armor too tough for the clamps of the little fungus to pierce, its ravages are confined to the more tender fruit-stems, and, those stems being blighted, the fruit dies, and gray rot, etc., are only the rottenness that follows death.

Secondly, The effect of our mildew on the leaves is far less serious than what the oïdium is reported to produce. But this may be because our leaves are thicker and tougher, and much more covered with down than those of the vine abroad. The comparatively delicate foliage of the Delaware certainly gives way very readily before a serious attack, while the leathery clothing of the Concord seems able to bear unhurt an indefinite amount of gnawing, if indeed the fungus is able to fasten on it at all. It is here to be noted, however, that while oïdium attacks both sides of the leaf, I have never seen or been able to

learn of any case where our mildew has invaded the upper side. Let me also note that M. Marès expresses the opinion that neither the hardness or softness of the fruit, nor the thickness or thinness of their skin, nor the lightness or heaviness of the down covering the foliage of the different varieties seem to make any difference with it.

Thirdly, and more to the point. A representation of the mildew as seen by the microscope shows a fungus somewhat different in shape from the oïdium as shown in engravings in European treatises. I myself can not say, nor will it be easy, I think, for any one to prove, that the differences thus shown are any greater than may well exist between two erysephes, or than distinguish the three varieties discovered by De la Vergne. It is pretty well agreed now that the European thing miscalled oïdium is an erysephe. Is our thing an erysephe? Yes; years before the "oïdium" appeared in Europe, a German botanist named "Schwienitz," who lived many years in America, discovered here an erysephe which preyed on the grape-vines of the *Labrusca* family. Montagne, the distinguished French mycologist, who made the vine disease a special study, referring to this discovery of the German, *gives it as his opinion that it was either the same as the European erysephe, or else a very near*

neighbor. Now, if M. Montagne can not tell us the difference between them, it can hardly be of any practical importance to know it, and would certainly be little worth our while to look for it. And we may dismiss the subject with the reflection that, after all, the distinguished, pestiferous parasite may have had its birth in our own country, and, though unnoticed, had a hand in much of the destruction that came upon our earliest vineyards before oïdium was heard of any where, and which destruction was all of it unjustly attributed to "*the rot.*"

But, in whatever respects they may differ, the oïdium and mildew are alike in this: that each comes in the form of a fine whitish dust, which afterward turns grayish, and then brown or black—each appears at the same epochs and returns after the same intervals—each acts in the same manner on the young berries—each flourishes best in the same state of weather, namely, a season of heat following a season of wet, while a long dry term is equally unpropitious to the progress of each. Finally, each is effectually destroyed by sulphur, which is the only practical point in my story, and, if the reader doubts it, this book is written to teach him how to make researches and experiments which will satisfy his doubts, and to help him test for himself the question whether or not the

vine shall live and flourish in the land, or perish and die.

Some confusion, both of words and ideas, has come from the habit we have fallen into of calling many of the consequences of mildew by the common name of *rot*. Mildew works its mischief by attaching itself to the surfaces of the leaf, the stalk, the stem, or the berry, and, as it grows, penetrating with its clamps, or grapples their outer skins, which it thereby disorganizes. The result of the disorganization thus effected is, sooner or later, the decay in some form of the parts attacked. Such decay, as noticed in the fruit, is commonly known as gray (or brown) rot, characterized by a mottled appearance under the surface, or as "calf's eye," so called from its circular shadings of dull brown hue, like the eye of a dead calf, and which mostly begins on the side of the berry, while "gray rot" begins at the base, where the stem joins, or takes the form of a falling of the fruit as it ripens, through general debility of the whole plant. These are merely different symptoms of a disease—the only disease properly so called which the vine knows. Separate from these symptoms, and independent of their cause, is an affection to which most American vines are extremely subject, and which is the only affection properly called rot. It is the "*black rot*,"

whose characteristics, origin, and history I will here endeavor to set forth, both to enable the reader the better to understand mildew and its cure, and to teach him, so far as I may pretend to teach, how to manage the rot itself.

CHAPTER IV.

THE BLACK ROT.

THIS is an affliction of sufficiently serious nature, resulting from bad drainage or bad ventilation, or both, in connection with peculiar conditions of the weather. It comes suddenly, with but few hours' warning at most. It appears at first in light brown spots, within which are often seen what looks like the gnawings of insects. These spots soon turn black—intense blue-black to the eye, but, seen through a magnifier, dark brown. They are generally round in form except on the leaves, where they are mostly angular and irregular. Spots of gray (or brown) rot begin at the base of the berry where the stem joins it, but spots of black rot are scattered indiscriminately over the whole surface. A single one of them will often cover half the berry, causing it to cave in. Black rot is prone to seize upon the fruit-stem, into which it will eat, leaving hollows like pits of smallpox. The result of such destruction of the substance of the

stem, where severe enough, is the subsequent decay of the one or more berries depending from and nourished by it, with much the appearance of gray rot (which last rot I attribute to the workings of mildew on the same stems). This result will be quick or slow, according to the degree to which the stem is injured. Spots of black rot, be they large or small, usually become dotted with little raised pimples of blacker hue than the rest of their surface, visible to the naked eye, and easily felt with the finger. As decay progresses it causes the discolored parts to cave in, and takes various aspects like decay from any other cause.

On the leaf black rot works quite slowly, and so it does on the stalk, but on the fruit or fruit-stems its ravages are rapidly accomplished. With a favorable change of weather it will go as quickly as it comes. This is seen where the state of weather that has brought it on is followed by a clear, bright atmosphere and fair sky. Then the spots take a brighter color, and seem to dry away, leaving harmless traces of rust-like appearance, sometimes covering the indented surface of scars more or less deep, whose after-effects will depend on their extent and the state of the atmosphere. The spots sometimes run together, or, rather, encroach upon each other, but otherwise they are apt to preserve their rounded and distinct

shape. Sometimes they are bordered at the edges with a lighter shade of color. Black rot affects certain varieties more than others, and, equally spotted with it, some grapes resist its action better than others, notably the Concords, owing to their thick skins and tough leaves. Its consequences are immediate, as when the berries are directly attacked; or consequential, as when they rot or atrophy through destruction of the fruit-stems or loss of vigor to the whole plant from ravages on the stalks or leaves. In short, black rot, like mildew, has many and divers manifestations and consequences, but is itself unmistakable, its characteristic features being the round or roundish and distinctly defined spots, their color black or blue-black to the naked eye, and dark brown when magnified, and the little black pimples which roughen their surfaces, though these last—almost invariably present on the berry—are frequently wanting on the other parts, in the earlier stages at least. But it is not a disease as mildew is, and medicine will not cure it.

Black rot is worst on soils that are compact or damp, and not well drained and in badly-aired situations. Fogs, frequent rains, and heavy dews are the active causes which produce it. A long and wet spring will predispose to it vines as well as other

plants, so as to insure a fresh attack with each recurring rain, or fog, or dew, followed by a hot sun. It is of the same nature with, or, rather, it is the same thing as, those mould spots which similar conditions cause to appear on apples, pears, and other fruit, and the blackness which dyes the silk of corn in wet seasons. It is carbon. In France they name it carbon, "*Charbon*," and, more scientifically, "*Anthracnose*," which means "*Black sickness*," for they have long known it in France, and know no good of it either.

The ancient Greeks, too, were acquainted with it; and Theophrastus, who lived three hundred years before Christ, has left us an account of it, which, though brief, enables us easily to recognize it. He described it as resembling rust in wheat, as causing a shriveling of the fruit, as coming "in damp weather, when, after an abundant dew, the sun darts down his powerful rays." He called it "*Crambos*." M. Marès, who resides in the South of France, thinks the Greek *Crambos* identical with the French "Charbon," which last he describes thus:

"It makes its appearance after a prolonged duration of dampness, when the weather is at the same time hot, heavy, and foggy, or after copious dews, and when, through an atmosphere burdened with vapor, the sun darts his ardent beams. But the al-

terations of heat and damp are never so serious in results as when they follow a prolonged term of rainy weather."

So much for the causes which produce it. For the effects of "Charbon," the same writer informs us that it makes irregular patches of black, sometimes bordered with yellow, to appear on the leaves, which cause them to curl downward, crisp, and fall [we must remember French grape-leaves are much more delicate than ours]; that it injures the young stem so the fruit below the affected part will shrivel and fall off; that it appears on the fruit only after it has attained some size, and in the shape of black spots, which harden and prevent its development.

He also adds that "Charbon" attacks the vines all of a sudden, and the injury is done all at once; that, when very recent, the injuries appear like brown spots or excoriations, as from insect bites; that usually several attacks occur in the course of one season; that as often as the fog or dew are abruptly succeeded by sunshine, the attacks are renewed, and can readily be counted; that the same kind of weather which brings rust to wheat, and spots pears and other fruit with black, causes "Charbon" on grapes.

Many persons in this country, confounding black rot with the symptoms and effects of the fungus we

call *mildew*, and searching in this rot for the causes of mildew with a view to its cure, and having discovered beneath the skin of the afflicted part a fungus of quite another sort than that of the mildew developed there, and which, growing beneath the skin, is, of course, inaccessible to sulphur, have thence inferred that sulphur could not cure mildew.

Now this subcutaneous fungus is of no sort of consequence either in relation to the curability of the black rot itself or to the curability of the mildew. Marès tells us that whatever fruit is affected by "Charbon," whether it be a mulberry, a pear, or an apple, there is a fungus present, concerning which, he further tells us, that it begins its life early enough to exist in those excoriations like the gnawings of insects which have been described, though it does not develop until several days later; *that it is not the cause of the disease, but its effect; that it is very small, conical, and grows beneath the skin.*

I think all who have observed the progress of black rot will recognize it easily in the above description of the "Crambos" of old Greece and the "Charbon" of modern France, and unite in thanks to M. Marès for shedding so clear a light on a dark subject. I hope, too, those who have suffered from this evil agent will take courage when they consider how, from imme-

morial time, those countries have endured its presence, and their grape culture survived its attacks. And such as have been careful to distinguish between the two will bear me witness that, as compared with mildew, black rot is not so very serious a thing but that our culture can survive it. Nor is it so very trifling a thing either but that we should seek out and apply the proper means to prevent it. Those means are drainage and ventilation, as is well known in the South of France. There they are careful also to plant in situations hard to drain, or where the air circulates badly, such varieties of vine only as are known to be least subject to the "Charbon." By such precautions they are able to keep the evil within reasonable bounds. My own vineyard being at the top of one of the 600 feet Scioto County hills, and 200 feet above the usual range of Ohio River fogs, and thus exceptionally well situated, I was able, by draining it, to keep the black rot so effectually in check during the season of 1869 that its ravages were barely noticeable, except in an undrained corner close to a thick wood. And in that year of 1869 that rot rioted throughout that valley, let me tell you. The corn-silk turned black as if dipped in ink, and every haystack looked as if covered with a pall. Apples and pears were discolored and distorted by it, and, as a

rule, only those grapes escaped the black destruction which the more swiftly-consuming mildew "ate to save them." But all sites and soils are not so favorable for being drained and aired, nor so free from fogs, as the high and dry hill where my vines grow. And, from what I saw in less favorable situations, I can well believe that for certain varieties there are vineyards in which, during seasons like that of 1869, the evil would be too inveterate to resist.

I am aware many persons have supposed gray (or brown) rot to be as distinct from mildew as black rot is, but observation will teach them that gray rot is only a consequence of attacks of mildew which come after the berry is more than half grown, and is the principal, and often the only form of injury which follows those attacks. They will also find, as I did, that sulphur prevents it, except where it (or something like it) results from the gnawings of black rot on the fruit-stems.

CHAPTER V.

REASONS WHY THE SULPHUR-CURE IS NOT PRACTICED IN AMERICA.

FAILURE OF EXPERIMENTS.—Many experiments have been thought to fail because those who made them did not clearly know the distinction between black rot on the one hand, and the gray rot, and other decay consequent on attacks of mildew, on the other hand. Some have thought mildew was one disease, gray rot another, and black rot another, while others have confounded all three in one general idea of "rot." And the observations in the last chapter on black rot, though sufficiently important in themselves, have been partly introduced to explain how experiments which may have well enough cured the particular attack of mildew against which they were directed, have, by those who conducted them, been considered failures merely because they did not also prevent black rot. Such persons may have applied sulphur enough to their vines, and yet their fruit has

rotted; and seeing this, they have abandoned the field in despair, whereas, had they persevered and closely observed, they would have learned in the end, as I did, that though, despite their efforts, black rot continued to work, even on grapes covered with sulphur-dust, yet that nothing else injurious had occurred; and would have found, when the season closed, that, although they had lost more or less of their crop from the "black sickness," yet that the far more terrible white one—the fungus of evil, the dire cryptogam of the accursed family of Mucedines—had not dared show his head.

Attenuations of Sulphur, or compounds in which the power of that drug has been weakened by mixing it with other inefficacious substances either dry or in solution, have again caused failures. Such mixtures, tried at certain times and on certain varieties of vine, have, even in our warmer grape districts, sometimes succeeded. The same mixtures, however, under other and less favorable conditions, have failed, and, by consequence, the remedy has fallen into disrepute and been abandoned. Mixtures which weaken the medicine do very well in the colder vine-regions of France and Germany, and, with certain varieties and in seasons when the disease is mild, do very well, too, in warmer districts, like the South of France; but ex-

periments made in the last-named district establish the fact that under a warm sun, adulterated sulphur, even when applied by skillful hands, can by no means be absolutely relied on. Far less could it be relied on in the hands of new beginners, making their first experiments in this hot climate of ours, so much nearer resembling that of Southern France than that of Germany. It was because of this similarity of the climate of most of our grape region to that of the Mediterranean shore that I studied the sulphur-cure there rather than on the Rhine.

BAD TOOLS will not do good work. The bellows hitherto relied on by the few who have attempted to combat mildew in America seem to have been made as complicated and expensive as could be contrived, whereas the best sulphur-bellows is the simplest and cheapest. An agricultural laborer who is asked to introduce into his accustomed routine of work a new series of operations, requiring care and attention to learn, and exactitude and fidelity to practice, ought not to be burdened at the outset with a clumsy, troublesome, inefficient implement; yet such have been all sulphur-bellows of American make I have yet been able to find. So great a disgust can they inspire, that a German who worked his own vineyard, and who tried sulphur on his vines, reported that it

cured them, but vowed he would never try it again—"it was too much trouble," he said. So I put down bad bellows for another cause of failure.

Ignorance of the Rules to follow in the practice of the sulphur-cure has been, after all, the chief cause of our failures. So far as, after much inquiry, I can learn, the translation of Marès's "Manual," which I embodied in my work on European Vineyards published last year, is the only manual of the cure yet printed in America; and what little knowledge on the subject we have picked up has been adapted to cold climates, where the noxious erysephe makes comparatively rare visits and has but a feeble growth, and not from climates analogous to our own. The principles to be followed are by no means difficult to learn or to follow, but they must be learned and followed, or there will be no success. If any American vine-dresser, who shall read the directions given in this little manual for sulphuring timely, appropriately, thoroughly diseased vines, will afterward say he has followed those directions and yet has failed, then his failure may be set to the account of the cure itself; otherwise to the account of his, and my, and our ignorance.

Belief that the American Mildew was a different Disease from the European Oïdium has largely

operated against our adopting in this country the remedy which has been so incontestably successful in others. All that bears on the question of the identity of the two diseases I have tried to give in Chapters II and III. But practically it is of no consequence whether they are different or are the same. Each is a fungus, and all fungi are cured with sulphur. For the use of this remedy was not the result of chance, but of scientific deduction, and the same indications which pointed it out as the true, reliable, and scientific cure of oïdium, points to it now as an equally suitable cure of mildew.

DELUSIVE HOPES IN NEW SOILS AND NEW VARIETIES have led our later enlisted and more enterprising grape-growers to treat all information relating to vine disease as concerning not them, but only the unfortunate owners of vineyards of Catawba in the older vine districts. And these, in turn, made despondent by the clamor in favor of lake-shore vineyards and Concord vines, have abandoned hope and ceased to strive against the fate, as they deem it, which dooms them and their property to remediless ruin. The "lazy Spaniards" and "enervate Italians" have learned what Americans have refused to know, and done what Americans have refused to do. They have learned what was good for oïdium, and they

have saved their grapes. Newly-planted vines and new varieties will, for a limited time, do well any where, and notwithstanding neglect and ill usage. Hence we from time to time hear of the wonderful productiveness of freshly-discovered grape districts, and especially of their immunity from disease. And doubtless the glowing accounts which come from one and another of the new fields of operation are to some degree founded in reason. We shall, for a long time, I hope, continue to hear of discoveries of more propitious soils and more valuable grape plants. But whoever hopes, by traveling ever so far, or hybridizing ever so industriously, to escape from the ordinary conditions of labor and vigilance to which all kinds of cultivation of the products of the earth are subjected by universal law, will find himself mistaken. Undrained soils will sooner or later breed the black rot, greedy pruning will sooner or later exhaust the best vineyards, and the spores of mildew, ever present in the atmosphere, will in their own good time find out the vines they so much love to afflict. In 1868 I visited some vineyards in a county into which grape-culture had but lately been introduced, and where hardly any thing but the Concord was known. Passing from one beautiful field where perfect health prevailed, and the assurance of an eight-hundred-gallon

crop to the acre gladdened the eye, for all was purpling for vintage time, and entering another adjoining it, I found disease to be playing havoc there. "Why is this?" inquired the owner; "the soil and exposure of both fields are the same, and the vines in both are Concords." "How old is the healthy field?" I asked. "Four years." "And the sickly one?" "Five." "Very well," says I; "see how your four-year olds do when they get to be five-year olds." The next year there came bad news from that county. And the same year, 1869, came also bad news from the new vine district of Crooked Lake, which had theretofore been esteemed so healthy. Now a safer place of refuge than the borders of Crooked Lake can hardly be imagined. The coldness of the climate is unpropitious to the development of mildew, and the decomposed shale* in the soil seems to have a positive preventive power, owing to the sulphur it contains; and seems, besides, to have other elements which give strength, and strength resists all diseases.

* Black shale, containing sulphur and various other ingredients beneficial to the grape, abounds not only in New York, where it first took the name of Hamilton Shale, but also in Ohio, Pennsylvania, and several other states. Many persons think its value is only beginning to be found out. It borders the eastern end of the shore of Lake Erie, and has a most marked development in the Valley of the Ohio below the mouth of the Scioto. It is not a coal shale.

If such a region has had to succumb, it will be hard to find one that will long remain exempt.

Taking the Catawba as a sample, the most rosy reports we have yet heard from any of the new districts are fully equaled by those published by Mr. Longworth and others in the earlier days of their success in the Ohio Valley. Yet what is the case to-day? Let all illusions be abandoned; let us look our foe closely in the face, feel his pulse, learn his symptoms, search out his causes and consequences, select the remedy, and faithfully administer it.

CHAPTER VI.

SOMETHING ABOUT THE EFFECTS OF SULPHUR ON FOLIAGE.

IT is not for the purpose of meeting any objection that may be abroad that sulphur hurts foliage, for I know of none, but because all facts bearing on the subject in hand should be noted, and as a caution it is prudent to give, that I here state a few facts of my own observing.

Resolved to leave nothing to chance, and do all in the most thorough manner, I gave directions, which I saw well carried out, to spare neither material nor labor; to give the disease enough of it. As a consequence of such heroic treatment, my Norton's Seedlings suffered severely in their leaves. The more sickly of my Catawbas too, after having endured and flourished under five superabundant powderings, each one twice or thrice too large, were evidently injured by the sixth, though but few leaves fell off, and the fruit ripened well, and though the healthy vines of

the same variety, and the few Concords in the vineyard, showed no signs of harm. Some Ives Seedlings in the neighborhood also suffered in their leaves, but only temporarily. I have also heard of an instance where some Herbemonts acted very much as did my Nortons. And, though unaware of any other cases like the above, I am prepared to learn that such have occurred, proving that certain of our vines are exceptionally sensitive to the action of sulphur, if given in unusually large quantities.

In Europe the effect on foliage of the drug in question is recognized as being so unqualifiedly beneficial, that they estimate the gain in productiveness obtained by its use quite compensates for the cost of both material and labor; and I feel sure, from what I have observed, that the same will prove true in this country. I noticed, in my own vineyard, what all I had read and heard on the subject taught me to expect, that within ten days from the dusting on of the sulphur the leaves grew deeper in hue, and showed a lively shining surface, as if they had been varnished, while the shoots sprouted upward with fresh vigor and spirit. The effect on the slight incrustation, organic and mineral, which will more or less cover and clog the pores of the leaf, as perspiration or dirt will clog the pores of the human skin, seems to be to

loosen it, so that the rains wash the surface cleaner than otherwise they would, thus giving a better access of air, and enabling those "lungs of the vine," as leaves are called, to breathe freer.

I also demonstrated the power of sulphur to destroy or chase away insects. Though appearing in considerable numbers on many of the vines just before the first sulphuring in July, they suddenly disappeared immediately after it, and, from that time on, hardly one sign of animal life could be seen throughout the field. But this complete extermination must be credited to the uncommonly strong doses given. Ordinarly less complete, yet still very valuable results in this respect are to be looked for.

So evident and well-known in France is the stimulating power of sulphur on the vegetation, that at first serious fears were felt lest the vines should be injured by over-stimulation; but such fears have long since vanished. In that country, the only effect of sulphur analogous to that I have noticed as produced on the foliage of certain varieties in this, is a "scalding" of the fruit, which in the South of France sometimes results from a sulphuring given during very hot weather, and on bunches exposed to the sun's direct rays. As a means to avoid this result, when feared, Marès recommends mixing the sulphur with lime, plaster,

etc., to weaken its power. And, should we in practice find, what I greatly doubt, that a proper use of sulphur injures any of our vine-leaves, we have here a hint of the proper precaution to take. Of course it would be possible to use, with as good effect, very fine sulphur by itself, if we had implements to distribute it thinly enough, which I think we might contrive.

I am sure that, in my anxiety to thoroughly test the value of treating mildew with sulphur, I put on more than twice what was needed, and twice as often as was needed. There is hardly any medicine that will not do harm if the doses are too large or too frequent. But I thought less of my vines than of the mildew I was dealing with. As I have before, and on another occasion said, "He who kills his first rattlesnake does not count the blows he gives." I think, too, the coarse flour of sulphur used held an excess of sulphuric acid, which injures foliage.

Again, the only vines observed to be seriously hurt by sulphur were Herbemonts and Norton's Virginia Seedlings, both of which are known to take mildew very lightly when they take it at all, and would therefore, it is probable, need but light treatment for their cure. There are several varieties of vine in the South of France which resist oïdium much better than oth-

ers, and such are found to be easily curable with the attenuations of sulphur before mentioned. It would be so, no doubt, with the two American vines just named. Both of these, it should be observed, belong to the family of *Vitis æstavilis*, while it was the other family, *Vitis labrusca*, that Mr. Schweinitz discovered the erysephe to be fond of preying upon. Very likely my Nortons would have escaped disease completely, even had they received no sulphur at all, as they had always done down to the time when I dosed them so rudely.

I dwell thus much on what relates to the Norton and the Herbemont, because I think them both of inestimable value, not merely for their remarkable exemption from disease, but also for the excellence of their products as wine grapes, and quite agree with Mr. Sanders that it is to the juicy and delicate family of V. Æstavilis we should chiefly look for our supply of wine rather than to the thick-skinned and hard-pulped musky generation of "Foxes," albeit the Catawba and Delaware, neither of which should by any means be despised, have come out of it.

CHAPTER VII.

EFFECTS OF SULPHUR IN THE WINE.

A BAD flavor is sometimes communicated to wine from the remains of sulphur on the grapes, and serious objections to the use of the remedy were at one time raised on this account. This taste it has, however, been found easy to get rid of by drawing off. If one operation does not suffice, a second in the manner prescribed below will be sure to succeed.

Rinse carefully your empty cask, first with cold, and then with warm water, then again with cold; for every forty gallons it will hold, pour in a quart of clean water, and leave it there. Burn within the cask, for every forty gallons it will hold, one square inch of rag or wick incrusted with sulphur by being dipped in it while melted; close the bung tightly, and roll and shake the cask to let the water within it absorb well the vapors of sulphurous acid produced by the burning. Into the cask thus prepared draw your wine, doing this by means of buckets, and not by any

of the modes contrived to exclude the air, since contact with it helps to disinfect the wine.

But be careful to leave all lees behind; therefore do not tip the cask. The thicker wine remaining with the lees must be settled by putting it in a smaller vessel, and then drawnig off by itself in the same way as the other. Any portion of lees carried into the fresh cask under the influence of a slight subsequent fermentation will again form sulphureted hydrogen, which constitutes the bad taste in question.

The above is from De la Vergne's "Practical Instructions."

This sulphureted hydrogen decomposes when brought in contact with the sulphurous acid produced by burning the sulphur-coated rag or wick, and thus the objectionable flavor passes off. But it will be slight enough to go away in the ordinary drawing off which must necessarily be performed for other purposes, unless sulphur has been applied to the vines late in the season, and in needlessly large quantities, and no heavy rain has come to wash it off, nor sufficient heat intervened to vaporize it away.

But the slight inconvenience of this sulphur flavor, so easily got rid of, is an inconsiderable evil compared with what results when, in absence of the proper remedy, the mildew, or its remains, passes into the wine.

For which reason it is always well to sulphur vines whenever any considerable attack of the disease occurs late in the season, even though it come too late to injure the fruit; for by fastening on such parts of the fruit-stems as yet remain green, it can maintain a foothold until vintage, and so find entrance into the press or vat.

M. Marès thinks the small quantity of sulphureted gas that will ordinarily be found in the new wine is valuable to preserve it, and thinks, too, the wine made of sulphured grapes is more even in quality, has a brighter color—very important in red wine—and keeps better than other wine; while De la Vergne says the time will soon come when those who buy wine of the producer will be glad to hear him say, "My vines were thoroughly sulphured;" and we all know that in commerce it has long been used to fumigate wine-casks, without complaint being made of any bad effect resulting.

CHAPTER VIII.

DIFFERENT PREPARATIONS AND MIXTURES OF SULPHUR.

POWDERED sulphur is made in two forms, one by sublimation and the other by grinding. Sublimated sulphur, commonly known as flour of sulphur, is usually finer than the other, and adheres better to surfaces against which it is flung. On the other hand, it contains six or eight times more impurity in form of sulphuric acid than the other, and costs considerably more. A good deal of inferior flour is made that is no finer than the ordinary qualities of ground. The value of powdered sulphur in curing the vine-disease depends on its fineness, other things being equal, since it is by the number of its grains its power must be estimated, and not by their size or weight; and, moreover, the finer the grains are, the better they adhere. The comparative fineness of two given samples can be pretty well ascertained by first weighing and then measuring them. The larger the bulk, the finer will be the quality; and the less the bulk, the coarser will be the quality.

But such a test, though sufficient for practical exactness where all the qualities to be judged are either flour of sulphur or else all ground sulphur, would fail to give a true idea of the comparative value of the two kinds in question, because the form of the grains of the flour is such that with equal fineness they adhere better to surfaces than those of the other kind, and because the ground is more movable—more dust-like than the other, and flies more readily out of the bellows or dredge-box; so that, fineness being equal, a pound of the flour will go farther than a pound of the ground. Care must be taken, when making the measurement, to pack the mass as little as possible, since but slight pressure would be required to pack the finer article within smaller space than the coarser occupied.

For a more scientifically correct test, M. Chancel, of Montpellier, in France, has invented the following method:

Weigh five "*grammes*," for instance, of the sulphur to be tested, and put it in a cylindrical tube of glass, divided off by a scale into a hundred equal portions. For five grammes the capacity of the tube should be twenty-five cubic "*centimètres*," so each division or degree of the scale will represent about one

fourth of a "centimètre."* That the mouth of the tube may be easily closed with the finger, its diameter should be about three fourths of an inch. In such a tube the sulphur will of course pack itself unequally. To correct the inequality, pour in gradually sulphuric ether, and shake until all the sulphur has entered into suspension; then fill up with more of the ether; shake again; set the tube aside and allow the contents to settle. The powder will pack itself regularly, and occupy within the vessel a space proportionate to its lightness—that is, its fineness. At the end of five minutes, if the experiment be with flour of sulphur, it will have settled entirely, and the result can be read on the scale. The better the sulphur, the higher will be the degree to which it reaches.

Exact as this test is for ascertaining fineness where applied to ground sulphur alone or flour of sulphur alone, it is only approximately so when the one kind is compared with the other, as the difference in the shape of their grains causes them to pack differently in the glass. Experiments made in the above mode by M. Marès gave the following results:

"Good flours occupied in the tube from 50 to 70 divisions of the 100.

* A "*gramme*" is about twenty-three grains, and one hundred lineal *centimètres* measure about thirty-nine inches.

"Flours of superior quality, very fine and homogeneous, filled from 75 to 90 divisions, and some were found, though rarely, which went up to 95 and even 100.

"Inferior flours were found which did not rise higher than from 35 to 40. Such hardly merit the name of flour of sulphur. They reveal to the touch much *grésil*, as little balls of sulphur are called in which the coarser qualities are apt to abound, and are very heavy.

"When the experiment is made with ground sulphur, a good deal more than five minutes must be allowed for the mass to settle, which is because this kind mixes with the ether differently from the other, forming a kind of paste.

"The greater part of the ground sulphur of commerce, made from rolls, measured in the tube from 35 to 40. The finest and purest I could obtain went up to 60 and 70. Common qualities of ground, of the fineness indicated by 36 of the scale, after being passed through a sieve of silk, indicated 43; this last, pounded in a mortar of agate, showed 60."

Ground sulphur seems to be as yet unknown in the American market. It may, however, be found that it will be economical for us to employ it on our vines if we can obtain a very fine quality of it, and very

cheap as compared with the other kind; and I have taken means to import a specimen of what is now commonly used in Italy, with a view of comparing it with the flour of sulphur made in America. It will follow, from what has just been quoted, that the question is a complex one of cost and quality.

Both kinds will cure the disease if brought in contact with it, and though in Europe disputes as to which is most economical still continue, both continue to be used. As the result of his own experience, M. Marès says: "I have tried ground sulphur on a large scale, and have obtained with it good results. Many others have done the same, and with like success. We must, therefore, admit its efficacy against the disease. Still I must say that the effects of the flour have been the most marked, and have determined me to give it the preference.

"Employing in my experiments flour of sulphur of 55 to 60 degrees of fineness according to the above scale, and ground sulphur of 35 to 40 degrees, I had to use on a given number of vines 75 per cent. more of the latter than of the former; that is to say, 100 pounds of the flour went as far as 175 pounds of the ground."

M. de la Vergne is even more positive than M. Marès in preferring the sublimated article. And yet

I think it is worth our while to look into the question for ourselves, not merely for the reasons I have above suggested, but because our present tariff puts so high a duty on flour of sulphur that none of it is imported, and we are forced to obtain what we may need from two or three large manufactories which enjoy the monopoly of the business. Thus, while in France selections can be made from the products of a large number of rival manufacturers, here we are reduced almost to Hobson's choice. Another unpleasant effect is that we are obliged to pay in gold for our sulphur twice what Frenchmen pay; and what is curious too is that, while the government compels us to pay this large price, not a cent of it goes into the government treasury.

Our manufacturers probably *can* make as fine sublimated sulphur as any in Europe. The question is, Will they find it profitable to do so? And to help them to a decision of this last question, we, who are likely to be such large consumers, may as well in time cast about us for a resort in case of need.

It costs four or five times as much to sublimate (distill) sulphur as it does to grind it. Grinding it could be well done, I should think, in a plaster-mill; but the process is dangerous, and, unless it be carefully managed, the mill will take fire. To refine the

crude article, all needed is to melt and run it into box-wood moulds, and there suddenly cool it, which converts it into what are known as "rolls."

Flour of sulphur is known from the other by its much brighter color and by being softer when rubbed between the fingers. Grains of the flour, when seen in the microscope, appear as round balls, while those of the other are of irregular and broken shapes.

VARIOUS MIXTURES OF SULPHUR with other substances in powder, such as lime, plaster, etc., have been recommended, and are used to a considerable extent. As the value of such attenuations is somewhat under discussion in this country, it may be well to give in this place the conclusions to which a committee of the Agricultural Society of the Gironde, in France, came, after a series of experiments conducted by them in the year 1861, which, for thoroughness, I would gladly see emulated in this country. The report of the committee sums up as follows:

"These experiments prove that oïdium is cured by powdered sulphur, no matter what be the shape of its particles, nor whether it be used by itself, or mixed with twice its weight of plaster, for the ground sulphur, as well as the mixture of plaster and sulphur, has repressed the oïdium at each application your committee made with these two powders. But the

same experiments also prove that the curative action of sulphur is more durable when applied in the form of good flour of sulphur. They prove, moreover, that a given quantity of well-made flour of sulphur has more virtue than double the quantity of ground sulphur, or three times the quantity of sulphur and plaster; so that, to perform the same duty, it is necessary to repeat the operation of sulphuring oftener with the two last powders than with the first, and, in point of view of economy of material and labor, the advantage, according to these experiments, remains with the good flour of sulphur. [The report states that all these powders were of the best quality and fineness.]

"Moreover, practice concurs with theory to prove the inferiority of all mixtures of sulphur with other kinds of dust.

"Experience proves that *dust from the road, ashes, lime, charcoal, mineral coal, plaster, and other substances, in a pulverized state, have not by themselves any power in curing the disease.*

"In mixing any one or more of these inert dusts with sulphur, you impart no virtue to it, any more than you increase the strength of a good wine by diluting it with water.

"On the other hand, although but a very small quantity of sulphur is needed in contact with the oïdi-

um to destroy it, yet there must be a minimum, less than which would fail of that end.

"That limited quantity, fixed by experience, is such quantity as, if well scattered, is sufficient to powder with sulphur all the green parts of the vine, so that a branch, or a leaf, or a bunch, looked at against the light, shows the grains very close together on all points of its surface.

"If great intervals existed between the grains of sulphur and the oïdium, whose organs are so extraordinarily loose, could it not maintain its place in certain cases and continue to develop itself?

"Now the quantity of sulphur indispensable to penetrate and envelop thus with a light cloud of dust the green parts of a vine could not be properly spread if it were mixed with a double or triple quantity of inert matter.

"Supposing the mixture perfect, each grain of sulphur must be separated from another grain by two or three grains of the other material.

"But the mixture is never perfect. Do what you will, the magnifying-glass will always show the pure sulphur resting in masses, more or less large, by the side of masses, more or less large also, of the material put with it.

"It is, then, evident, that if you spread on the sur-

face of the plant a quantity of the mixture only equal to the quantity of sulphur needed to preserve that plant, you will not obtain the effect desired.

"But if you must employ, to do the work that one pound of pure sulphur would do, three pounds of a mixture whereof one third is sulphur and the other two thirds inert matter, why not, by means of well-made instruments, spread upon the vines to be cured the one pound of sulphur by itself, and save the cost of the other useless ingredients, as well as the labor of handling them?

"It appears, besides, that those useless ingredients diminish, to a certain degree, the action of the useful one, since the pure flour of sulphur employed by our committee produced a more durable effect than a triple quantity of the mixture, one third of which was sulphur.

"Again, that which our experiments have enabled us to affirm concerning a mixture of two parts of plaster with one of sulphur only confirms the result arrived at by trials made in the Gironde since 1859 by many different persons, as well with the above compound as with others, which the minutes of a great number of your sessions will attest."

A LIQUID PREPARATION OF SULPHUR AND LIME is often recommended. It is prepared by mixing together

equal quantities by weight of sulphur and newly-slacked lime, and boiling them in eight times their weight of water, during ten minutes, in an iron vessel. After settling, the liquid is drawn off clear, put in bottles, and well corked. For use, one gallon of this is mixed with a hundred gallons of water, and with the mixture thus prepared the vines are syringed. Thorough experiments made in different parts of France have resulted in the abandonment of this "sulphur of calchium," as they there call it. It costs little, but must be frequently renewed on the vines. Its liquid form is objectionable, and, after all, it is thought the only virtue it possesses rests in the sulphur. Those who might feel disposed to try this preparation should not attempt to vary the proportions of the ingredients, for a given weight of sulphur will combine with the same weight of lime, and with no more.

To save the trouble of inventing and trying other methods for curing the vine-disease, I will here mention a few that have been fairly tried in France and found to be failures:

1. Painting the old wood, after stripping off the loose bark, with a solution of sulphate of copper, four pounds of the sulphate to one hundred pounds of water.

2. Painting with an alkaline, soapy liquid, enveloping as active agent either arsenious acid, or a salt of arsenic, or sulphuret of soda.

3. Coal tar, smeared on the old wood after stripping off the bark.

4. Whitewash.

5. Washing the fruit with soap-suds.

6. Fumigating under a cover with burning sulphur.

7. Quicklime, ashes, plaster, and other kinds of dust.

8. Scorching or singing the vines after winter pruning by means of torches.

9. Scalding with hot water, at the above epoch.

10. Brushing the surface of the fruit.

11. Burying the vine.

12. Pruning early.

13. Pruning late.

14. Pinching the buds.

15. Layering the entire vine.

16. Layering the branches only.

17. Grafting.

18. Different kinds of manures.

19. Painting with potato-glue mixed with sulphur.

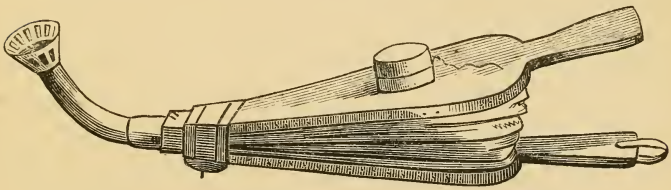
Many of the above, it should be remarked, had a measurable success, but none were found fit to adopt in practice. Layering the whole vine, I am led to think, might succeed with some varieties, and in fa-

vorable soils and situations. I found the people of Burgundy and Champagne thinking favorably of it, and disposed to attribute their exemption from the disease to their mode of cultivation, which involves layering; but those are cold vine-districts.

CHAPTER IX.

IMPLEMENTS PROPER TO USE.

THE Bellows, of simple construction, invented by M. Vergnes, is the most approved implement yet discovered. It has been improved upon by M. de la Vergne, and the improvements patented.



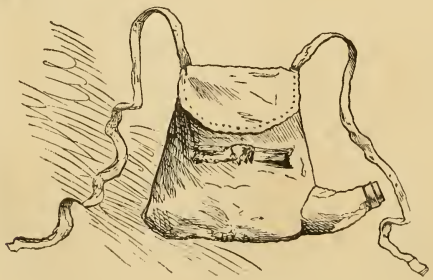
Its dimensions are those of a common kitchen bellows. The boards are of poplar, two fifths of an inch thick, and well seasoned. There is no metal about it, except the tin pipe (or nozzle), and the tacks which fasten on the leather. It is thus seen to be very light, a most important consideration.

In the middle of the upper board is a round hole one inch and a half in diameter, to which is fitted a stopper attached by a cord to the bellows.

The pipe is in one piece, regularly curved, or in several pieces jointed with solder to form the proper turn. The outside end, or mouth, is covered with a wire-gauze sieve of tinned wire, whose meshes are a twelfth of an inch square, giving 144 of them to the square inch. Round this sieve is a trumpet-shaped addition, with openings in the sides, forming around the sieve a sort of little railing to protect it against any dampness which may be upon the vines.

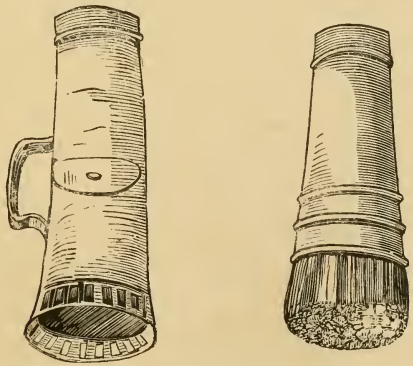
Of M. de la Vergne's improvements, the most important is that which protects the leather from destruction through corrosion by the sulphur or other material used. Another regulates the quantity of the charge, and another still the volume of the discharge.

A CANVAS BAG, fitted with a tin discharge-pipe, and large enough to hold four or five pounds of sulphur, is hung round the neck, and carries the supply with which to renew the charge of the bellows as often as that is exhausted.



If, however, two or three are engaged in the work, it is greatly expedited by adding to them a boy, whose duty shall be that of "*powder-monkey*." He will be kept busy by giving him three spare bellows to charge with sulphur from a stationary supply, and carry them to the men, receiving in return their empty ones again to be filled. In such case no bag is needed.

The Dredge-box is made of tin, in different forms, two of which are represented below. The smaller end, into which the sulphur is introduced, closes with a snugly-fitting cap or cover. The large end has a double bottom of tin pierced with very fine holes, through which the sulphur is to be shaken out; and there are also a few cross-pieces of iron wire fixed about an inch above the upper one of the two plates



forming the double bottom, and which serve to break up the lumps. I have seen very good dredge-boxes of American make, with bottoms of fine brass-wire gauze. I thought these too fine, and removed one of them; but it might be well to retain the double sieve, though making the upper one coarser than the other. The meshes of the one should measure about one twelfth of an inch across, and of the other about one twenty-fourth. The length of such boxes is from eight to ten inches, and the diameters from three to four inches.

The dredge-box is common in most of the vine-countries of Europe, and, though a good deal more wasteful of sulphur than the bellows, is useful for many purposes where the latter would not work well; as, for instance, to sulphur in May, when the young shoots are quite small, or late in summer, when, as sometimes happens, only the fruit-bunches need the operation, or to use for branches of unstaked vines which droop on the ground.

THE TUFTED DREDGE-BOX is the same just described, except that it has the addition of a tuft made of woolen yarn, four inches long, fastened to the larger end, which tuft receives the sulphur as it issues from the box, and sifts and disperses it in finer dust than would be shaken out but for its interposition. Marès con-

siders the tufted box an improvement on the other, of which he has a poor opinion; while De la Vergne thinks it good for little or nothing, and praises the other. Both kinds are used in Europe, and both should be tried here.

A little Brush, formed of a bunch of coarse bristles tied together, should be carried with the bellows, to keep the sieve at its mouth free and open.

Other implements have been invented besides those I have described, especially bellows mounted with different sorts of tin boxes and funnels, which, after being tried and condemned elsewhere, have come across the water to plague the few of us who have had enterprise enough to try the sulphur-cure, and have helped such to make failures. I have tried many of them, and read and heard of others. Their faults are: Sieves, often double ones, quite too fine; mouths too contracted; valves to draw in the air, which, always coming in by one way and going out by another, inevitably packs the dust against the meshes of the sieve, instead of which the machine should breathe in and blow out through the same hole, thereby continually cleansing the meshes as the Vergnes does; complicated construction, with its easily imagined difficulties; heaviness; weak construction, which, in connection with the tendency to clog, involving the need of

frequent shakings, makes them soon shake to pieces; prices twice or thrice equal to that of the simpler and better article. In short, they are well adapted not to do the work, but to wear the muscles, tear the nerves, and exhaust the patience of him who handles them. Until some genius shall invent precisely the right thing, the Vergnes bellows and the dredge-box are the only implements to use.

CHAPTER X.

WEATHER SUITABLE FOR SULPHURING.

ONLY in the greatest emergency would it do to sulphur vines while it rained. I know it has been recommended, and is even practiced in the colder grape regions of Europe, to perform the operation early in the day, in order that the dew on the lower side of the leaves shall cause the powder to stick there; but such is by no means the practice in those hotter countries where the disease is strong. The sulphur, being insoluble in water, acts on the disease only in the form of vapor, and it will not turn to vapor except in a heat equal to about 68° Fahrenheit. There is no use in putting it on unless the thermometer shows that temperature to exist in the vineyard at the time it is put on, or afterward and before it is blown or washed away by wind or rain. Fortunately, a greater heat is required to bring the mildew into life than to produce the vapor which destroys it. As much as two or three hours at least of the right tem-

perature are needed to make the remedy take effect; and, if a considerable rain should fall before such time has elapsed, the work must be done over again within two or three days afterward. After the leaves have grown large enough to shelter the fruit, and to some extent each other, as in late June, such a renewal becomes less important.

CHAPTER XI.

HOW TO CONDUCT THE WORK.

THE dredge-box is of course worked by shaking the sulphur out of it. Care should be taken not to overload it, nor to dredge too much powder on a given surface, the liability to an extravagant expenditure of material being the chief objection to this implement. In other respects, the rules given below for using the bellows sufficiently instruct in the use of the dredge-box.

The proprietor must first learn how to blow the bellows, and then teach his assistants. The motions of the handles must be short and quick, and not long and slow; they must also be regular, and, so far as can be, uninterrupted. When operating on a vine from the top downward, the cessation of motion as the bottom is reached is apt to clog the pipe. This is corrected by briskly shaking the instrument on recommencing. In whatever position it is held, it need not get clogged if, while changing direction, the quick,

short motions are uninterruptedly continued. The object to be kept in view is to put a little of the sulphur every where, but not a great deal any where. "*The work is well done*," says Marès, "*when, on taking a leaf or fruit bunch, and holding it against the light, numerous grains of sulphur, no matter how small, are seen to cover all points of the surface. The work is ill done, on the contrary, when the vine or the soil at its foot show lumps or patches of the material.*"

De la Vergne says: "*A workman who handles his bellows well disperses the sulphur every where equally, and the vines he has gone over are perfectly well covered, while, at the same time, one who looked at them in passing would not discover, except by the smell, they had been sulphured at all.*"

It is best always to begin by blowing from the bottom of the vine upward to the top, all the while throwing the sulphur under the leaves and toward the centre, and then proceeding from top to bottom, all the while throwing the sulphur on the upper sides of the leaves, and so all round the plant. The workman should walk entirely around each vine as he dusts it; or if, it being on a trellis, he can not do this, he should pass down the line, sulphuring on one side as he goes, and then pass up again, doing the same on the opposite side. The motions for each plant should be the same,

so that, after a time, a habit of regularity and exactitude may be acquired that will insure thoroughness and avoid omissions. The negligence of workmen is the frequent cause of partial sulphurings being needed to cure particular vines on which the disease was imperfectly cured, so that, in a few days, it breaks out afresh.

The workman should keep his eye on the clouds of dust he blows from his bellows, to see how they drift and where they lodge, and so manage with regard to distance, and position, and the course of the wind, as that they shall go where they are wanted.

It is a great fault to overcharge the bellows. A pound is the most that should go in at one time. He must also acquire the habit of knowing when all has been expended and the time has come to load again.

If, as sometimes happens, sulphur-dust is found to hurt the eyes of the workmen, they must be furnished with goggles, such as stone-cutters often wear. Outside shirts or blouses of close cotton or linen stuff should also be supplied them, to protect their clothes. Care should be taken to so instruct and encourage them at the outset that they do not take an early disgust, which will make them either quit the work or do it negligently. Properly equipped, and taught, and encouraged, they will soon find the work to be

not at all unpleasant; whereas, if clumsy, heavy implements are put in their hands, to weigh down their arms, to worry them by frequently becoming obstructed or getting out of repair, or with holes in them through which the dust blows out backward, or if left to find out for themselves how to meet all the little difficulties which are apt to beset every new beginning, they will be like to leave you suddenly in the most pressing exigency that can come upon a vine-grower.

CHAPTER XII.

OF THE PROPER TIMES FOR SULPHURING.

UNDOUBTEDLY the true principle is to sulphur the vines as early as the disease appears, and again as often as it reappears. But, in order to do this, we must be able to recognize the appearance of the disease, and, furthermore, to know of its approach a little while before it invades the whole vineyard, for it works quickly. And although, in the beginning of our experience, few of us will be able to discern in season the signs of warning, and must rely on sulphuring at stated times—the rules for which I will presently give—yet it is proper we should at once begin to learn how to recognize the presence of the disease, and how to get warning of its approach.

How to recognize the Presence of the Mildew. —It is only with the first stage of the disease that we have to do, for all which comes afterward is but the decay in different forms, by wilting, cracking, rotting, etc., which results from the first stage, and it is only

in that stage sulphur or any other remedy can do good. On the leaves, stalks, and fruit-bunches there will come spots of what appears to the naked eye as only a fine white powder, but which, examined under a microscope, prove to be hosts of little fungi (mushrooms). At first they may be brushed off with the finger, without leaving on the surface where they rested any injury or appearance of injury; but, if allowed to remain long enough, will throw down little claws, which will pierce and grapple to the outer skin, and, by thus wounding it, cause all the decay which renders mildew such an affliction to the vine. Most American vines are so covered with down in every part, there is some risk an unpracticed observer may sometimes mistake it for the powder which reveals the presence of the little innumerable mushrooms in question. Where the mass of them is considerable, as I have found it on one of the new hybrids, the musty odor exhaled, and which French writers all mention as being peculiar to the oïdium, can be easily recognized, though not so easily forgotten. Sometimes, too, we may be deceived by fine cobwebs freshly woven, or even by spots of dust splashed upon the lower leaves by rain.

TO GET WARNING OF THE APPROACH OF OÏDIUM, it is the custom in Europe to establish in each vineyard

several "*Ceps moniteurs*," as they are called, or *signal vines*, as we will term them; for, whenever a general attack impends, certain individual vines will be observed to catch the disease a few days in advance of the great body of their own variety; and as different varieties take the disease at different times and in different ways, therefore each variety must have its own signal vines. We should look for such in depressed places — on the borders of alleys, under the shade of trees, or where cold and damp exhalations come from some adjoining woods or swampy ground. When discovered and well tested, they should be marked so as to be easily found.

Having established proper signal vines, the approach of danger can always afterward be known by simply watching them, without the need of going over the whole vineyard. As soon as any of them give warning, all the vines of their variety should be sulphured without delay. But first the signal vines themselves should receive a thorough operation, in order that another and false alarm do not too early follow in consequence of their not being radically cured; and for the same reason, in serious cases, they may need a second operation a few days later.

Until we shall have learned well how to recognize the presence of the mildew, and have established our

signal vines, we shall be obliged to rely on sulphuring at certain fixed times, as at first they were obliged to do in France, and as new beginners there are still advised to do. In such case the recommendation of Mr. Marès is to *sulphur regularly once in every twenty days, beginning as soon as the young shoots are two inches long, and continuing until the changes of color in August tell that the ripening process has begun in the fruit*, which saves it from farther danger. This is the simple rule I followed during the season of 1869, and which effectually saved my crop.

M. De la Vergne recommends novices such as we to sulphur, *first*, just as blossoming is about to begin; *secondly*, as soon as blossoming has ended—two epochs which in his district occur, the first between May 20th and June 10th, and the second between June 20th and July 10th—and *thirdly*, toward the end of July, when the August growth begins, terminating at the same epoch with the rule Marès gives, for a sulphuring late in July will ordinarily save the fruit until ripening time. These three operations, he thinks, will generally prove sufficient. It will be seen they are separated one from another by *thirty* days, or thereabout.

Mr. Du Brieuil, in his able work on vineyard culture—which no American vine-grower should be with-

out—gives a third rule, not intended, however, like the two just given, to suit the case of new beginners in the practice of the cure, but which is still worth quoting here. It is this: Sulphur *once* when the young shoots are only six inches long; *a second* time during blossoming; *a third* time when the fruit has grown to one third its full size; and as often besides as the signal vines give warning of disease.

Another rule, not a rule of stated times, like those of Marès and De la Vergne, but, like the one last given, intended for persons experienced in the sulphur-cure, is prescribed by another very respectable authority. It is this: Give *one sulphuring* fifteen days before blossoming; *a second* during its continuance; and *a third* fifteen days after its close; besides others as often between times or afterward as the signal vines show the disease to be at hand.

It will be perceived each of these four rules makes blossom-time the governing epoch—the point from which to count, and thus each is based not merely on the time (24 days) the oïdium requires to reproduce itself, but also on certain stages in the growth of the vine itself which seem favorable to develop that fungus. As regards our mildew, it also seems very much influenced in its comings and goings by the stage of growth of the vine, as all who have observed it will

admit. How apt it is, for instance, to appear about the time when the berries are just formed, and again when they have reached one third or half their full size.

Thus we have, to aid us in watching our vineyards and in studying the nature of our enemy, a knowledge, first, of the time needed for the fungus to reproduce itself; and, secondly, of the times when the state of the vine invites its attacks. We also know the kind of weather most suited to its development, namely, hot and dry succeeding to terms of rain. And now let us survey the field of our operations with a view to discovering the rules to follow with our own somewhat peculiar vines. From the first putting forth of the young shoots in spring down to the end of vintage and the time of leaf-fall, grape-vines are liable to attacks of mildew. This period let us divide into three—the first extending from the awakening of vegetation until blossom-time; the second reaching from then until the time when the fruit, beginning its changes of color, shows ripening-time to have come; and the third lasting from then till the end of the season.

FIRST PERIOD.—In Europe, owing to the delicate nature of their vine-foliage, every considerable development of oïdium on leaf or stalk requires attention

and recourse to the remedy almost as urgently as if the fruit itself were attacked. With American vines it is quite different. Excepting, perhaps, the Delaware, the leaves and stalks of our leading varieties seem nearly invulnerable to mildew. I have known it to fasten on the foliage of a vineyard of Catawbas, Ives, and Concords, and work there undisturbed for six or seven weeks without seriously hurting its growth or impairing its usefulness, if, indeed, leaves could be said to have any use when the fruit they were intended to nourish and ripen was rapidly rotting away. A week of such work on European vines would pretty surely have turned them yellow or stripped them bare. This peculiar hardiness of ours is due, possibly, to the toughness of the leaves, and the down which so thickly covers and protects both stalks and leaves.

The American grape-grower, then, being relieved of any fear lest a great and sudden calamity surprise him during the period now being considered, there can be no good reason for beginning operations under the twenty-day rule of Marès until blossoming time. But, whichever rule we follow, a good look-out should be kept, and, if signs of mildew actually appear, a sulphuring should be given to the infected vines at least.

The approach of blossom time brings us toward the close of the first period, and to the moment when it will be necessary to decide between the two rules first above given, namely, the *twenty*-day rule of Marès, which, modified as above, prescribes one of the sulphurings to be given at blossom time, and the others to come every twenty days thereafter, and the *thirty*-day rule of De la Vergne, who tells us to begin just before blossom time, to repeat just after it has ended, and repeat again about the end of July. One says, "Sulphur your vines while the blossoms are open, whether any disease be present or not; it will aid in the process and increase the product." The other tells us, "Do no such thing unless there is disease to be cured." Which authority ought we to follow? Evidently neither exclusively until the method of each has been tried, carefully, observantly, and frequently.

Following the thirty-day rule, and supposing no actual invasion of mildew to have happened, we give our first sulphuring at that stage of growth of the fruit-buds which shows the blossoms are about to open. As to the necessity or utility of beginning thus early, we are as yet too ignorant of the mildew's doings during this first period to know. The wise principle, however, which tells us to check all disease

in its earliest attacks, is by Du Brieuil, expressly applied to the case of oïdium; and I well remember a neighbor who sulphured a part only of his vines before blossoming, and then sulphured all of them afterward, told me those which received but one operation did not so completely escape as those which got two.

The Second Period begins with the opening of the blossoms — the time, according to Marès's rule, for giving the first stated sulphuring. It should be done while blossoming is at the height, and certainly before any of the more precocious vines have got through and begun to form their fruit. The first stated sulphuring, whether performed before blossoms open, as De la Vergne directs, or after they are open, as Marès directs, should be a complete one, covering the whole vine except old wood, regardless of the presence or absence of mildew, and should be performed with a bellows. In the case of Norton's Seedlings, or other varieties peculiarly sensitive to sulphur, some of the mixtures before mentioned might be used, or, what might do better and be equally safe, very fine sulphur, thinly but thoroughly spread, as has been said before.

All other sulphurings might be confined to the fruit-bunches alone, unless other parts be actually

mildewed, or the signal vines show them to be on the point of being attacked, in either of which two last cases the whole vine, in all its parts, should receive a sulphuring. Whenever the fruit-bunches alone are sulphured, it should be done with a dredge-box.

The practice of sulphuring the fruit-buds without the rest of the vine, although not sanctioned by any thing I have read in Marès or De la Vergne, is nevertheless distinctly authorized by Mr. Du Brieuil, who recommends us to do the last sulphuring upon the fruit-bunches only, and with a dredge-box.

There will be cases in this country where the malady, leaving the fruit-bunches untouched, will attack only the leaves, or the stalks, or both. In such cases, *if we sulphur at all*, we should operate on all parts, the fruit-bunches as well as the others, for while we are about it we may as well include the whole vine. But must we always sulphur in such cases? That is a question we can not answer to-day; nevertheless, let us consider it.

Considering, then, how the toughness and downy coating peculiar to our American vines seems to separate the fate of their leaves and stalks from that of their fruit, so that the fruit may be attacked and the body of the vine escape, or the body be attacked and the fruit escape, the question is whether, while faith-

fully watching for and promptly attending to all attacks upon the fruit-bunches, we may in any measure neglect attacks which confine themselves to other parts, and, if so, in what measure may we so neglect them?

On the one hand, we know that attacks of mildew will often pass away of themselves without any treatment, which are cases of spontaneous cure, as they are called in France. And in this country we may expect, for the reasons above given, that such attacks, if confined to the stalks and leaves, may continue for several days, and, unlike what happens in France, pass off without having inflicted any serious injury upon those parts, and without hurting the fruit at all. On the other hand, we know disease breeds disease, and that, if mildew is allowed to range unchecked over the foliage, there may be danger of its falling suddenly upon the fruit between one sulphuring of the latter and another. We know, too, that every considerable injury sustained by the body of the vine must in some measure affect every member of it. But, though it would look like bad husbandry to tolerate in any degree the presence of the pest, yet economy must not be forgotten, and if time and practice prove it safe to spare any considerable portion of the cost and trouble of sulphuring, then time and practice will have borne valuable fruit.

The completion of the blossoming process and the formation of the young berries bring us to the point of time when De la Vergne's second stated sulphuring must be given. To help to understand what he means by designating for the first operation "the moment when blossoming is about to begin," and for the second that "when it has just finished," bear in mind that he places these two moments thirty days apart. This will, in the climate where he writes (the neighborhood of Bordeaux), bring his second sulphuring to the 1st of July as an average date; and he sets his third sulphuring for about the 1st of August. In our own grape region, the epochs he indicates will generally be separated by the same interval of thirty days. Now, however reasonable it may seem thus to base our operations as to time upon the approach of those stages in the vine's growth which seem to favor the development of the disease, and however our own experience thus far seems to confirm the opinion that those stages are the same with our vines, and their mildew as with foreign vines and their oïdium, yet we should not forget there is a law of growth controlling the reproduction of the fungus—in Europe at least—by which it is able to reappear in twenty-four days after being suppressed. So it would seem prudent in such as adopt the thirty-day rule to look

out well during the last six days of the time, and be prepared, if disease appear, to meet it with the remedy.

In following the twenty-day rule it would be economical to begin as late during blossom time as safety permitted, and also to prolong the intervals to about twenty-four days, in order that the third operation should come late enough in July for its effects to extend to ripening time, and thus one sulphuring be saved. But weather is uncertain. Delays are dangerous. If we undertake to follow a rule, it is better to go through with it. I well remember the only sign of mildew I found on any of my vines during the season of 1869 was on some of them which the intervention of two holidays and two days of rain compelled me to defer sulphuring till the twenty-sixth day; therefore the beginner would do well to allow of no postponement that could be avoided.

If, after reading the above, any one shall ask why it is I counsel for trial a method which extends the intervals between sulphurings to *thirty* days, I answer that I rely much on the epochs of the vine's growth which De la Vergne chooses for his sulphurings. They seem to come opportunely to meet the disease at its chosen times for appearing, and so to be capable of a more complete effect than if given be-

fore or after such times. M. Marès himself counts much on the opportuneness of the sulphuring, as well that of blossom time as that of the last of July, and only recommends the twenty-day practice to those in the condition in which we of this country now find ourselves, and who wish to secure certainty of result.

Thus we reach the close of our second period and the safe end of our summer with three stated sulphurings, or at the most four, according to the plan adopted. It is my belief that, in most seasons and with most varieties, two of these sulphurings may be safely confined to the fruit-branches alone, and be done with a dredge-box, and one only be needed that shall include the whole vine and require a bellows; namely, the one at or about blossom time. Moreover, once we shall be provided with proper signals, vineyards in districts as favorably situated in respect to disease as those of Médoc in France may usually escape, as happens there, with but two stated sulphurings, and perhaps one or two partial ones. What is here meant by partial will be explained farther on.

THIRD PERIOD.—After the grapes begin to change color, though no fungus can hurt them, yet, if the vines have been allowed to suffer frem neglected attacks of mildew, the fruit will begin to rot and fall just as it is becoming fully ripe—a trouble nothing

will help except a premature gathering to press. Again, the as yet green fruit-stems may become coated with mildew, which, though unable to injure the ripening fruit, may nevertheless pass into the wine, and do much injury there; and accumulations of fungus on the leaves, even late in the season, will, to say the least, do no good. Therefore it will sometimes happen that a sulphuring will be proper even in the third period; though, if the vines have been kept healthy and sound down to the end of July, it will be very rare that any subsequent trouble can come to them.

Partial Sulphuring.—Negligent workmen, bad sulphur, or insufficient tools will often cause individual vines to fail of a cure. The fungus will perhaps die down to the roots, but these will in a few days sprout up with a new growth. Within four or five days, therefore, after each general sulphuring of mildewed vines, it will be proper to carefully search through the vineyard for such cases, and renew the operation. If the case be very serious, it would be well to renew once more within five days after, or cut the affected branches off and fling them away.

CHAPTER XIII.

MISCELLANEOUS.

THE COST OF SULPHURING.—The luxuriant vines of Southern France require, in an average year, from eighty to one hundred pounds of flour of sulphur to the acre, and from four to six days' labor to put it on. The small, though closely-set vines of the neighborhood of Bordeaux require, in an average year, only about fifty pounds, but need the same amount of labor. In this country the quantity needed would be midway between the two, and the labor would be about the same. In France sulphur costs $2\frac{1}{4}$ to $2\frac{1}{2}$ cents a pound for the finest and best; in this country it costs over twice as much. With these data, any one may easily compute the probable expense of saving his vines from destruction; he will not find it very dear. The finer the sulphur, the farther it will go. Should we be able to obtain, in this country, as fine an article as the best they use abroad, the sieves of the bellows and dredge-boxes might be reduced in size, to economize its expenditure.

CULTIVATION.—Whatever tends to keep vines in strong health helps them resist the disease, therefore cultivation should be thorough and frequent enough to secure such a condition. But manuring has a decidedly bad effect when the substance used is not well rotted. In every case freshly-manured vines should not only be well cultivated, but also sulphured with extra care. New earth spread about the roots has a most excellent effect in helping to resist disease. Where a vineyard is conveniently near a forest, leaf mould should be preferred to every other kind of manure; but where this is obtained from damp places, it should, like swamp muck, be allowed to remain a year in heaps, or properly treated with lime, before being hauled on.

DRAINAGE.—Infinite loss and discouragement have come to American vine-growers from neglecting to drain. In Europe it has been the custom, from time immemorial, to drain in some form all vineyard soils not naturally dry, or made so by being walled up in terraces. In the beginning we were led to think drainage unnecessary because we trenched our ground very deep, which so loosened up even the toughest clay that, for a while, it did very well; but in time it relapsed to its former condition, and was as bad as before. No clayey soil can, in the long, grow healthy

vines unless properly drained—*unless very thoroughly and carefully drained;* and, as most of our vineyards are of such soil, their owners had better abandon them if not prepared to make the needed expenditure. As a safeguard against black rot it is quite indispensable, being, as before stated, the chief preventive to that affliction.

RESTORING DECAYED VINEYARDS.—Many vineyards have become so exhausted by neglect, disease, and want of drainage that something more must be done for them than merely giving medicine. Proper means should be taken to restore such, which means, however, it is not the purpose of this little work to describe. Most valuable directions will be found in M. Du Brieuil's work on "Vineyard Culture," in Chapter XII., on "Maintenance and Renewal of the Plants." I have myself tried layering somewhat on the plan he there advises, and like the result. Besides, layering, though perhaps not reliable as a cure for mildew, certainly acts against the disease, and will materially assist the sulphur in working its effect.

PECULIARLY SUSCEPTIBLE.—Beyond question some varieties will take the disease, as some will take the black rot, much more readily than others. The Catawba has hitherto been the worst sufferer, and the Isabella has escaped the best. But the Catawba is

worth saving, and the other is not. The Catawba has got a worse name than it deserves. It has had the misfortune to be the victim of all the mistakes of new beginners in vine husbandry, and has been abandoned to the ravages of both mildew and rot till they have gained a certain foothold on it. And yet it seems to me it is very easily cured of mildew, however it may be with black rot. In France they have established six categories of vines, arranged in order of their susceptibility to the oïdium. The Catawba appears in the *last* category, as being, with the Isabella, the least susceptible of all. From this it can be imagined how much more fortunate we are than vine-growers in that country, who, nevertheless, in practice have little difficulty in combating the disease; and from this we may infer, too, that if any of our varieties have to be abandoned as incurable, it will not be the Catawba, the King of the Cobblers. If I may be allowed to predict, the varieties we shall first be disposed to cast away are some of those now counted among the indestructibles, honestly puffed and believed in as such, because not old enough to have come under the control of disease.

If, again, I should name the vine which I think best able to resist disease, and which, even if attacked, is most worthy of rescuing from its clutches, I

would name the Norton's Virginia Seedling, whose crystal-clear and garnet-red juice, full-bodied and rich—whose "vinosity," "neat" flavor, and delicate aroma merited and received at the hands of the jury of the Paris Exhibition of 1867 the highest mark accorded to any of the ninety samples of American wine which I had the honor to present for their tasting. As this vine puts forth at least ten days later, and ripens at least ten days earlier than the Catawba, and has, at the same time, a surplus of sugar, it is adapted to a wide belt of our vine region, and is worthy of trial in even our most northern districts. Wherever planted, however, its fruit should be fully fermented on the skin to make a red and not a pink wine.

SULPHURING APPLE AND OTHER FRUIT-TREES.—About the time of the appearance of the oïdium in Europe, there came a crowd of other cryptogams, which alighted on apple, peach, quince, and apricot trees, as well as on clover, sainfoin, violets, roses, and many other plants. They all made themselves known by a whitish dust, the same to the naked eye as the oïdium, and worked similar evil effects; but none of them were identical with it, and it was found, on examination, that each species of plant had its own variety of cryptogam, and, upon attempts being made

to communicate that which fed on the vine to other plants, however near to it in kind, the attempts all failed. Nevertheless, each variety of cryptogam yielded readily to sulphur, and it was applied with great success to the fruit-trees especially. Doubtless "this is what's the matter" with much of our fruit. In fact, careful observers have, for some time past, called attention to "mildew" as afflicting our peaches and apples; and that disease, with black rot, which has spoiled the shape and quality of half the apples we are eating at this present writing, in connection with negligent cultivation, are reason enough for all the prevailing lamentations over the decay of our orchards.

I thought I greatly improved the yield and quality of my apples last year by sulphuring the trees while in blossom. I hope others will try the remedy—as I also will, and more seriously the next time—and observe and report the results. One application would not, of course, test the full value of the system; and though, on the more robust fruit of the tree, destruction by disease will be less marked and less rapid than on that of the vine, it would be no more than prudent to sulphur once at blossom time, and as often afterward as signs of disease should appear; or else to sulphur, without regard to signs of disease, three times,

somewhat following De la Vergne's thirty-day rule as applied to the vine. My trees being young, I found no difficulty in blowing on the sulphur with bellows of ordinary size and shape; but, for large trees, the nozzle should be elongated by one or more joints of tin pipe, which was the expedient resorted to in France.

Try it!

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